eGROUNWATER
Working paper 1

Participatory Groundwater quality monitoring in Lebanon

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In brief – In this project, university staff trained citizen scientists to perform groundwater quality testing at village level, in southern Lebanon. The information they produced helped volunteers identifying drinking water contamination sources and proposing remedial actions. A water committee composed of volunteers was established to continue water quality testing. It however stopped functioning after a few years, due to lack of funding, conflict with the municipality and declining motivation.

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eGROUND WATER
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Context and innovation

In 2014-15, the Nature Conservation Center (NCC) of the American University of Beirut (AUB) established a community outreach program entailing the participatory mapping of natural and cultural landmarks in 50 villages. The population of one of those villages placed the need for clean drinking water amongst the top three environmental priorities in the village. Inhabitants expressed serious concerns about the poor quality of drinking water supplied by the municipality and by private well owners. Their demand was to assess water contamination risk, to identify where contamination was taking place (groundwater, pipes, storage tanks) and to propose remediation actions.

It is in this context that the AUB initiated the **participatory groundwater quality-monitoring** project. The project involved local volunteers in the collection of water sample and their chemical analysis, with the support of the municipality. The project started in January 2015 and was completed in September 2017. The innovation was twofold: it not only consisted in enrolling lay people in technical tasks that are usually carried out by skilled scientific experts, but also in empowering them to participate in the analysis of the data generated and in the decision making process. Indeed, participants were able to use data they produced to influence the diagnosis of the problem as well as the decisions taken to solve the water quality problem. The following paragraphs describe the main steps of the project and the results obtained, based on several publications and an interview with two members of the research team.

Innovation implementation process

The project was implemented as part of a scientific project initially designed by academic experts. Although the initiative did not come from local stakeholders themselves, they were included in the definition of the project objectives and methodology from the very beginning of the activities. The critical steps of the process were (i) the recruitment of participants, (ii) their training, (iii) and the organization of data production.

Recruitment of volunteers

An introductory presentation of the project was organized in October 2015 and the municipality invited all residents to attend, through letters sent to NGOs and clubs.

Project presentation meeting on 31 October 2015 (46 persons interested in participating). © R. Baalbaki

The research team asked the 46 participants to fill out a survey to evaluate their perception of water quality issues. A workshop was then organized to discuss quality parameters that would be monitored and to identify water sources that the citizens would like to test. Based on discussions with citizens, the municipality and private well owners, it was decided that water samples would be taken from three public wells, three private wells

and two water storage tanks. This participatory definition of the objectives contributed to strengthen volunteers' engagement.

The recruitment of volunteers was supported by the municipality and by two women engaged in two NGOs (representing the two dominant political parties) who actively contributed to the recruitment. Twenty-four citizens accepted to be involved in the collection of water samples and their analysis, using a mobile laboratory, which was installed in the village. Communication with those volunteers was organized using What'sApp messages.

Private well owners were, initially, reluctant to participate in the study because they were concerned about the lack of objectivity and reliability of the tests performed by local residents. This concern was addressed by explaining the methodology, which consisted of blind sample testing and verification of the results in the university lab. To get them on board, the team had to make clear that the water quality testing campaign aims to ensure the public good and not the shaming of private businesses. The status of the university researchers facilitated building confidence and enabled the involvement of citizens in this sensitive issue.

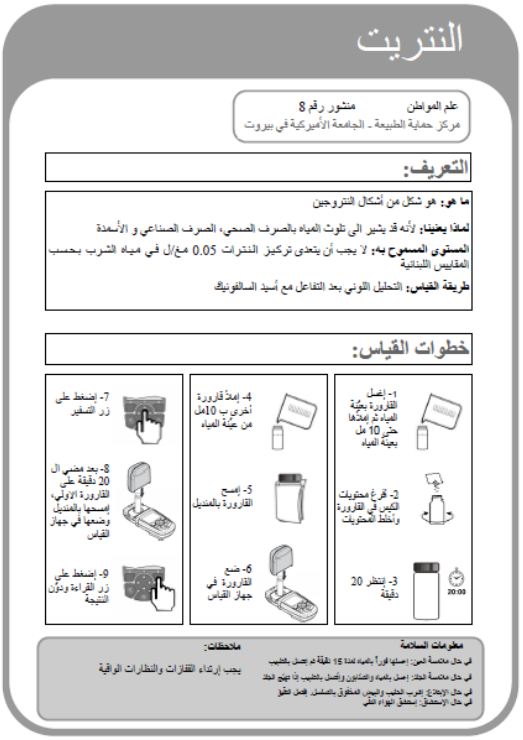
Concerning volunteers' motivations, the project coordinator stressed that while some volunteers were primarily interested in the technical and scientific aspects of the tests (learning motivation), most were clearly motivated to solve their water supply problem, through identifying which sources were contaminated. Female participants were mostly interested in conducting water test analyses, while male participants (although they were a minority) were more engaged in collecting the samples. After initial enrolment, obtaining effective participation to the project activities was not always easy. Despite their motivation, female participants did not have much time to dedicate to the testing, as Rima Baalbaki, a graduate student, recalls:

"I was mainly working with mothers who were only available for a few hours when their children are at school and when they do not have to do house chores. So, I was the one preparing all the test tubes and material beforehand, labelling them and putting things so that they can directly start with the testing. I was also the one cleaning everything afterwards." "Some citizens left in the middle of the project, but others joined in and there was always a core group of enthusiastic citizens involved who trained newcomers. So it became like a social gathering more than a task and this is where the buy-in became very important." (Rima Baalbaki)

Training of volunteers

The research team trained volunteers on how to do water testing for 12 water quality parameters (9 chemical, 3 biological). Several meetings were arranged with the citizens, and six water testing full day workshops were held over a year. These workshops were used to explain various aspects of water quality and to train them to perform the various water quality tests. Fact sheets written in simple layman language and with illustrations, were distributed to the trainees, explaining the testing methodology for each parameter. Logbooks were also provided to volunteers to record results.

Researchers observed a lot of peer teaching and cooperation between citizen scientists, which they explained by the culture of mutual support between women in rural Lebanon.


النتريت

علم المواطن منشور رقم 8
مركز حماية الطبيعة - الجامعة الأميركية في بيروت

التعريف:

ما هو: هو شكل من أشكال النتروجين

لماذا يعنينا: لأنه قد يشير الى تلوث المياه بالصرف الصحي، الصرف الصناعي و الأسمدة

المستوى المسموح به: لا يجب أن يتعدى تركيز النترات 0.05 مغ/ل في مياه الشرب بحسب المقاييس اللبنانية

طريقة القياس: التحليل اللوني بعد التفاعل مع أسيد السالفونيك

خطوات القياس:

1- إغسل القارورة بكمية المياه ثم إملأها حتى 10 مل بعينة المياه

2- أفرغ محتويات الكيس في القارورة واخلط المحتويات

3- إنتظر 20 دقيقة

4- إملأ قارورة أخرى ب 10مل من عينة المياه

5- إمسح القارورة بالمنديل

6- ضع القارورة في جهاز القياس

7- إضغط على زر التشغير

8- بعد مضي ال 20 دقيقة على القارورة الاولى، إمسحها بالمنديل وضعها في جهاز القياس

9- إضغط على زر القراءة ودوّن النتيجة

معلومات السلامة

ملاحظات:
يجب إرتداء النظارات والنظارات الواقية

Fact sheet and instructions to conduct a chemical analysis

Organization of water sample collection and analysis

The University team planned the sampling campaigns in cooperation with the local village representatives. Two campaigns (one in August and September 2016 and one from November 2015 to February 2016) were conducted with each consisting of three sampling events in ten water sources. The involvement of the local citizens led to choosing the water sources that are most relevant to local residents.

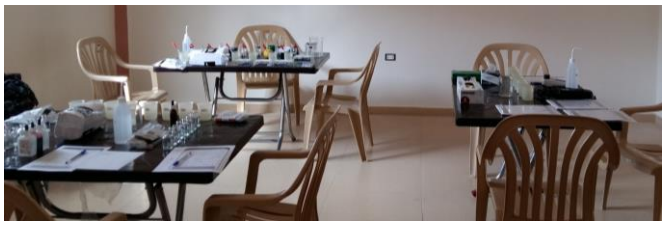
Taking sample in a public well. © R. Baalbaki

A mobile laboratory was installed in the village. Water samples were tested for a total of nine physical and chemical parameters (pH, electrical conductivity, turbidity, hardness, alkalinity, nitrates, nitrites, ammonia and phosphates) and three biological parameters (total coliforms, fecal coliforms and E. coli).

Field testing kits and laboratory supplies were provided to the citizen scientists. The kits were chosen for their ease of use, testing duration and sensitivity. The water sampling kits and the water testing kits were prepared at AUB before going to the village. This included labelling all

the test tubes and sample holders beforehand to make the sampling and testing procedures faster (as the time with the citizens was limited).

The mobile lab



Techniques used

- Instant measurement devices to test for pH, conductivity, dissolved oxygen and turbidity.
- Titration based techniques to test for water hardness and alkalinity
- Colorimetric techniques after chemical reaction to test for the concentration of nitrate, nitrite, ammonia, and phosphate
- Filtration followed by incubation on growth media to test for total coliform, total fecal coliforms and E. Coli

© R. Baalbaki

Citizens performed the tests for the chemical and physical parameters as well as the bacteriological tests for the summer campaign and analyzed the results. Since they conducted the tests on coded water samples that were doubly blinded, they were unable to analyze the spatial distribution of the results. It was only later that they discussed the results and remedial solutions.

Quality of data produced by citizen scientists

One of the key issues was to ensure the quality of data produced by citizen scientists. The following approach was implemented. First, sample analysis was doubly blinded. Second, the water samples were both analyzed in the mobile lab by volunteers and at the university's laboratory by researchers. Data generated by the citizen scientists using field kits closely matched for most of the water quality parameters. There were some discrepancies concerning the hardness and phosphate data as well as the biological parameters.

Impact of the process on water management

Impact during the project period

The results of water tests were discussed in a public seminar attended by all stakeholders including citizen scientists, private well owners, representatives from the municipality and a

local school, and concerned residents. Discussions about the quality of the water and whether or not the water can be used for drinking, bathing and food washing actively engaged the local community. Results in particular helped identifying several causes of poor water quality including the contamination of one public, one private well and one reservoir; they also suggested by one public well which had previously been closed by the Ministry of Health was safe to used. Remedial actions were also discussed, including the installation of water treatment units and corrective measures to the reservoir. Some of these actions were actually implemented (installation of a small disinfection unit) but not all.

Citizen scientists continued discussing via a messenger group and the project eventually resulted in the formation of a local water committee in charge of organizing future water quality monitoring at the village level. At the end of the project, the University team concluded that "*the water committee empowered by scientific tools can ensure the sustainability of [the] initiative in the village*".

- ## Long term impact

At the end of the project (2017), which only last for two years, the equipment was donated to the community, with sufficient supplies (chemicals, etc.) to run the mobile laboratory for a year. However, according to one of the authors, the community monitoring definitively stopped in 2019. One of the explanations given is the lack of financial support from the municipality to the committee. Another is the declining interests of volunteers: despite the high commitment of the women and men of the village, it clearly did not top their priorities. Moreover, until now, this type of participatory groundwater quality monitoring had not been duplicated in others villages, or initiated by others projects in Lebanon.

- ## Lessons learned

To involve people in a participatory project, it is important to take their social norms into account. For example, in the case of this Lebanese village, respecting and adapting to local cultural practices allowed the success of the project. In addition, people may be motivated by getting a better understanding of groundwater issues in their community and being directly involved in solving local environmental problems.

However, there may be power struggles between stakeholders, which can hinder the continuation of a project. In this case, a dispute between the water committee and the municipality prevented people to keep testing water quality at some sites.

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